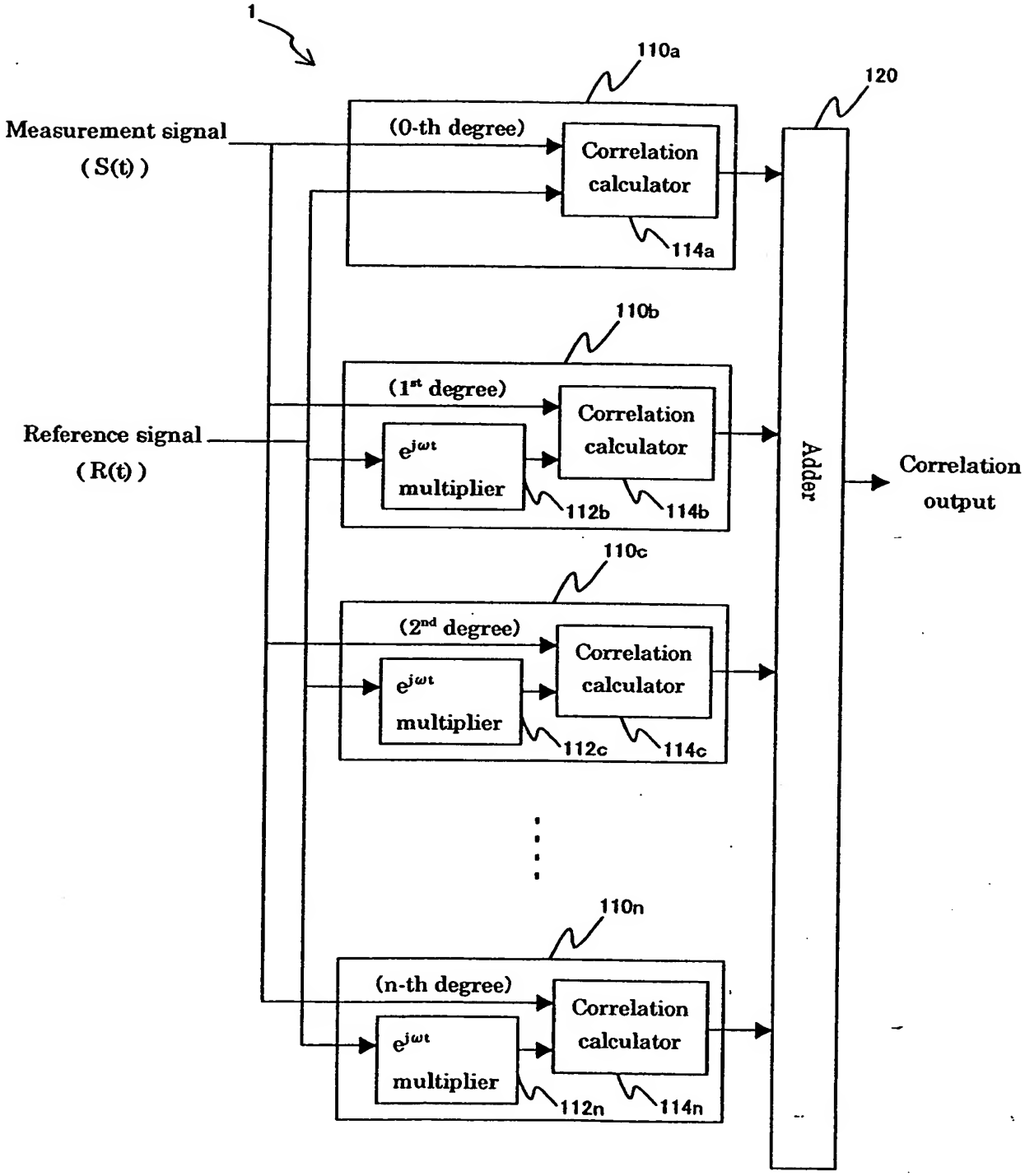

1
110a
120
Measurement signal
(S(t))
(0-th degree)
Correlation calculator
114a
110b
(1st degree)
Reference signal
(R(t))
Correlation calculator
e^jωt multiplier
112b
114b
Adder
Correlation output
110c
(2nd degree)
Correlation calculator
e^jωt multiplier
112c
114c
110n
(n-th degree)
Correlation calculator
e^jωt multiplier
112n
114n

Fig. 1

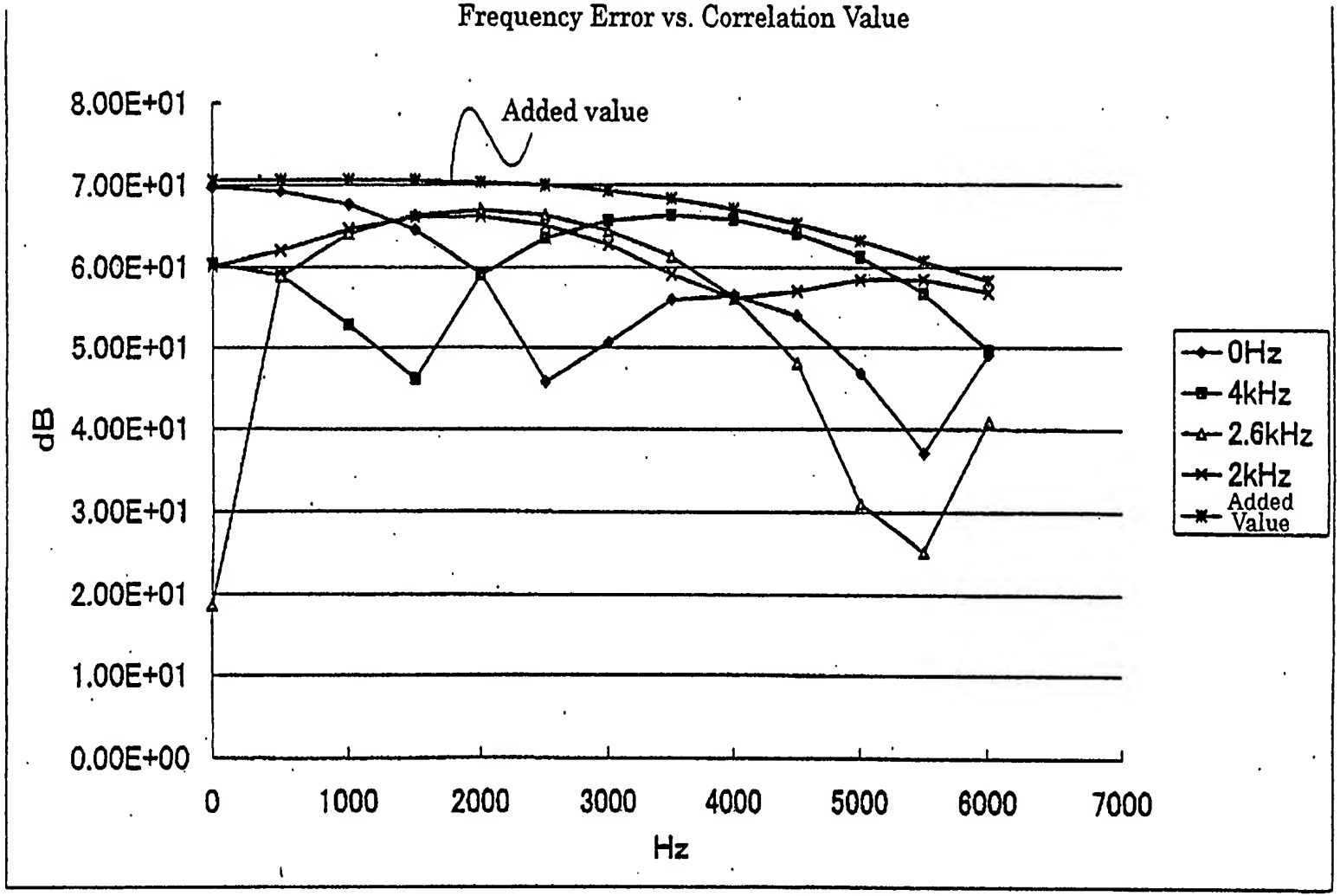

Frequency Error vs. Correlation Value
Added value
8.00E+01
7.00E+01
6.00E+01
5.00E+01
4.00E+01
3.00E+01
2.00E+01
1.00E+01
0.00E+00
dB
0
1000
2000
3000
4000
5000
6000
7000
Hz
0Hz
4kHz
2.6kHz
2kHz
Added Value

Fig. 2

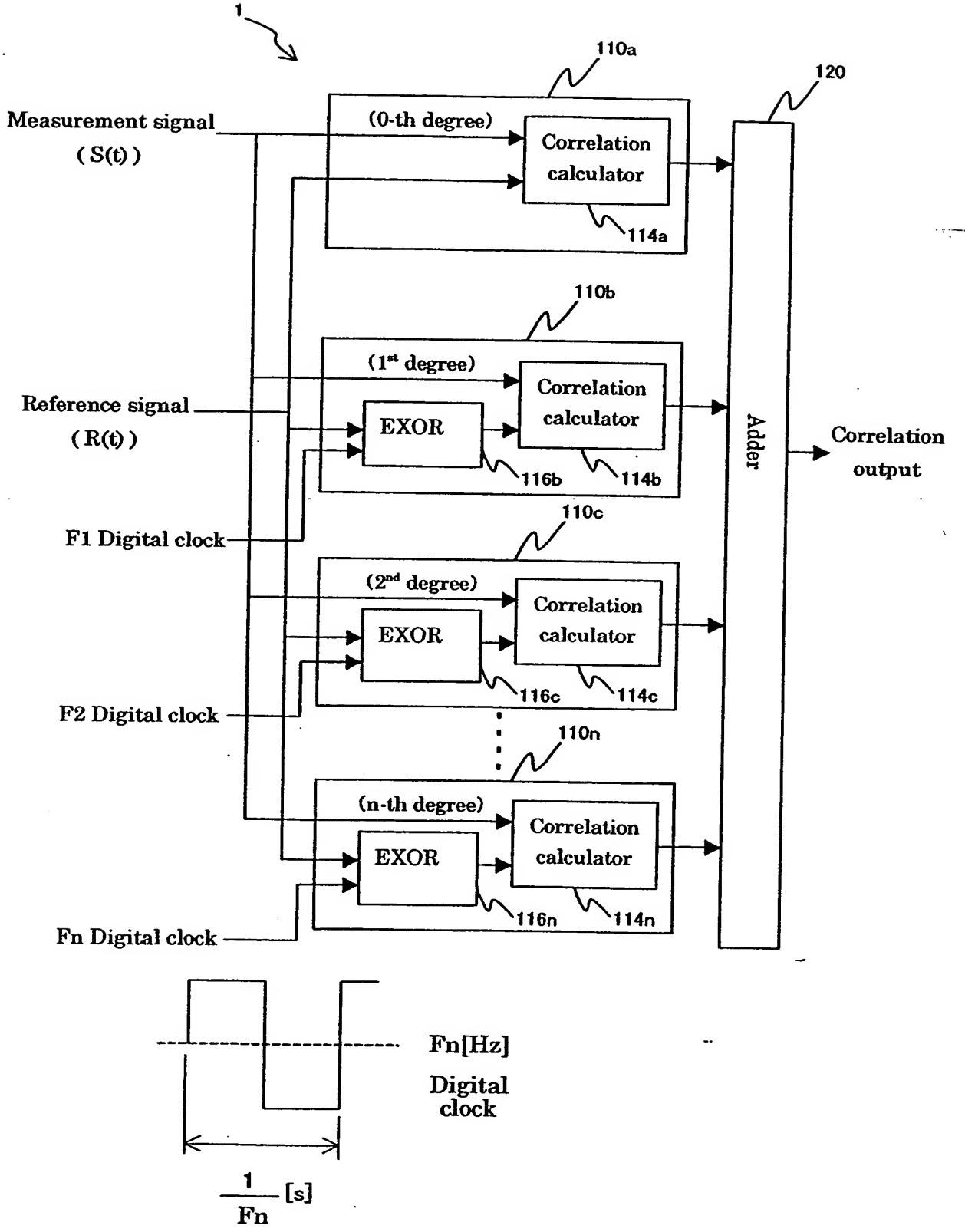

1
110a
120
Measurement signal
(S(t))
(0-th degree)
Correlation calculator
114a
110b
(1st degree)
Correlation calculator
Reference signal
(R(t))
EXOR
116b
114b
Adder
Correlation output
110c
F1 Digital clock
(2nd degree)
Correlation calculator
EXOR
116c
114c
F2 Digital clock
110n
(n-th degree)
Correlation calculator
EXOR
116n
114n
Fn Digital clock
Fn[Hz]
Digital clock
1/Fn [s]

Fig. 3

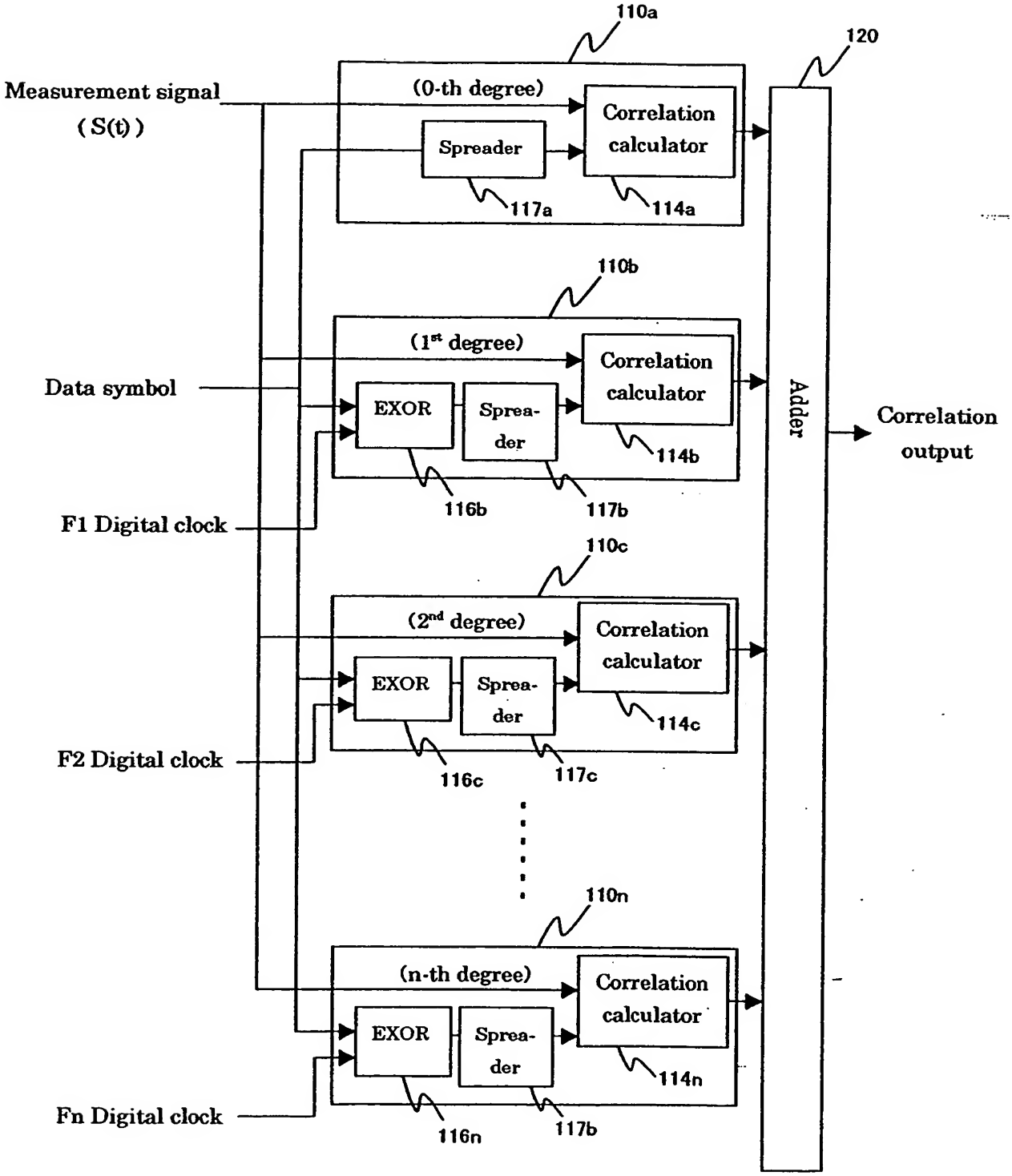

110a
120
Measurement signal
(S(t))
(0-th degree)
Correlation calculator
Spreader
117a
114a
110b
(1st degree)
Correlation calculator
Data symbol
EXOR
Sprea-der
114b
116b
117b
Adder
Correlation output
F1 Digital clock
110c
(2nd degree)
Correlation calculator
EXOR
Sprea-der
114c
F2 Digital clock
116c
117c
110n
(n-th degree)
Correlation calculator
EXOR
Sprea-der
114n
Fn Digital clock
116n
117b

Fig. 4

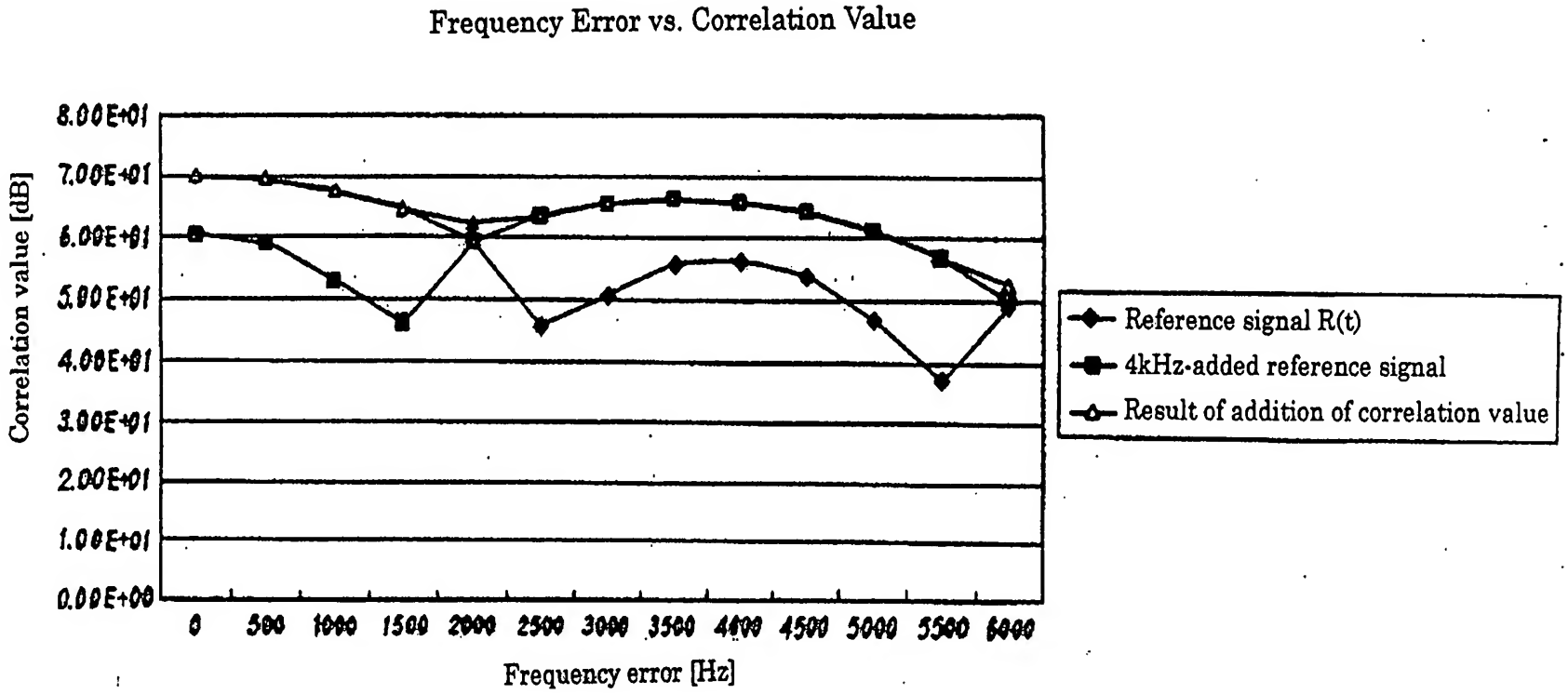

Frequency Error vs. Correlation Value
Correlation value [dB]
8.00E+01
7.00E+01
6.00E+01
5.00E+01
4.00E+01
3.00E+01
2.00E+01
1.00E+01
0.00E+00
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency error [Hz]
Reference signal R(t)
4kHz-added reference signal
Result of addition of correlation value

Fig. 5

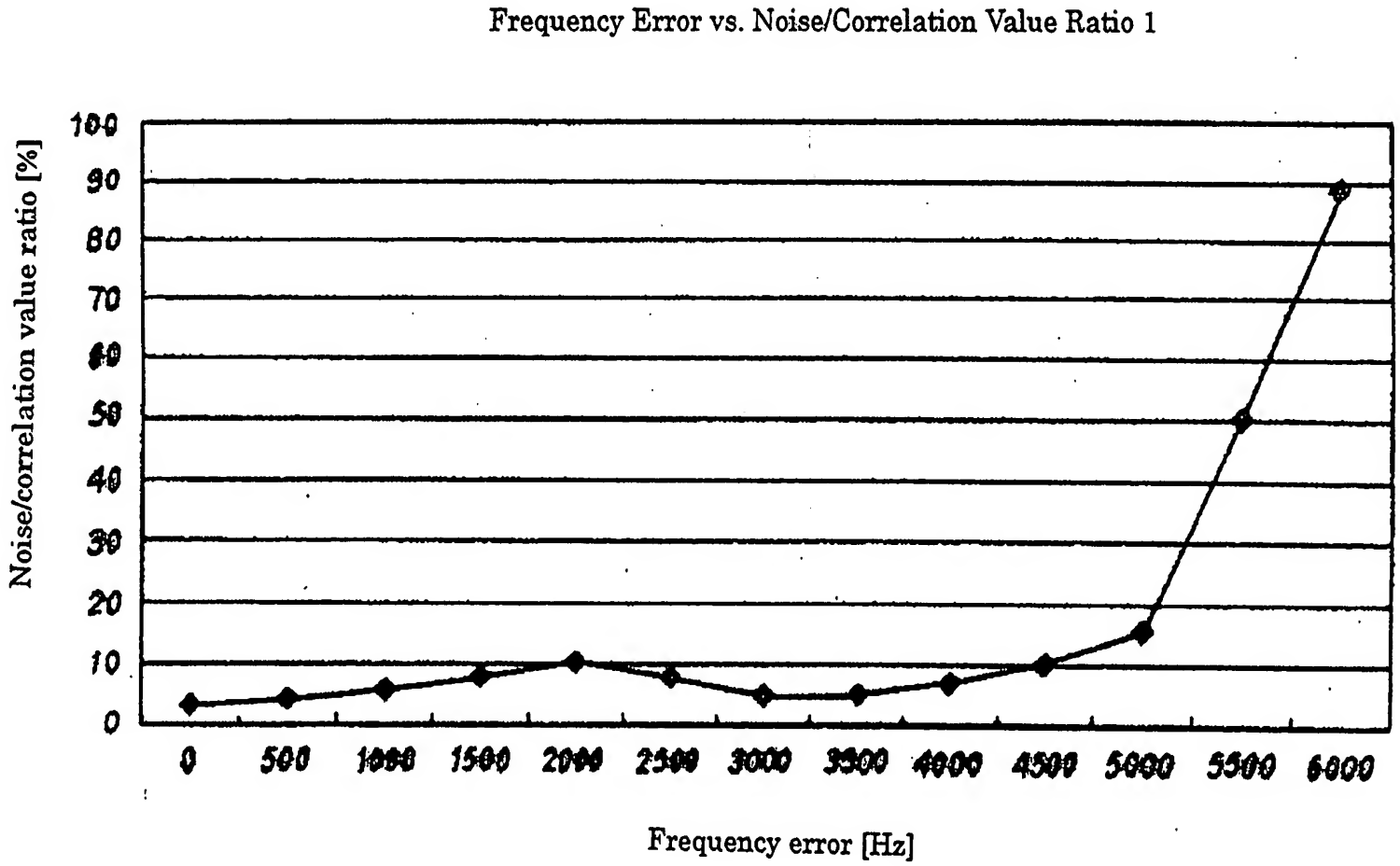

Frequency Error vs. Noise/Correlation Value Ratio 1
Noise/correlation value ratio [%]
100
90
80
70
60
50
40
30
20
10
0
0
500
1000
1500
2000
2500
3000
3500
4000
4500
5000
5500
6000
Frequency error [Hz]

Fig. 6

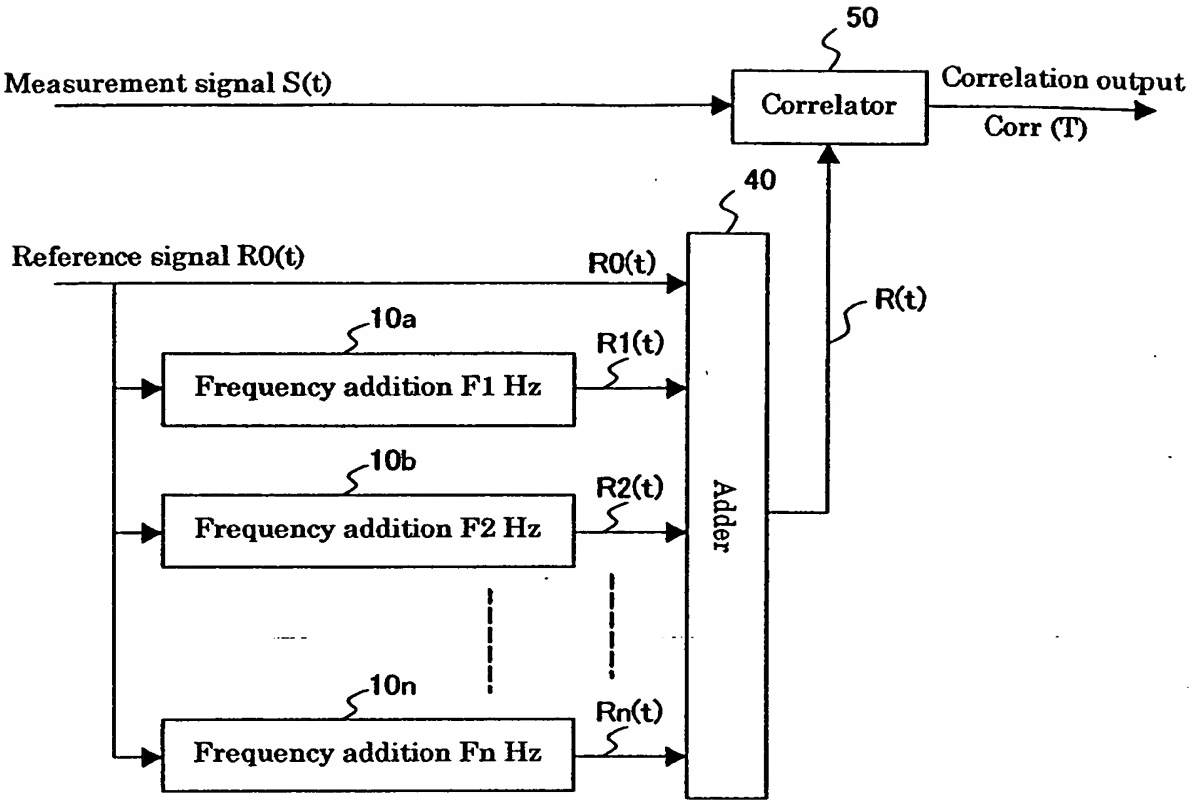
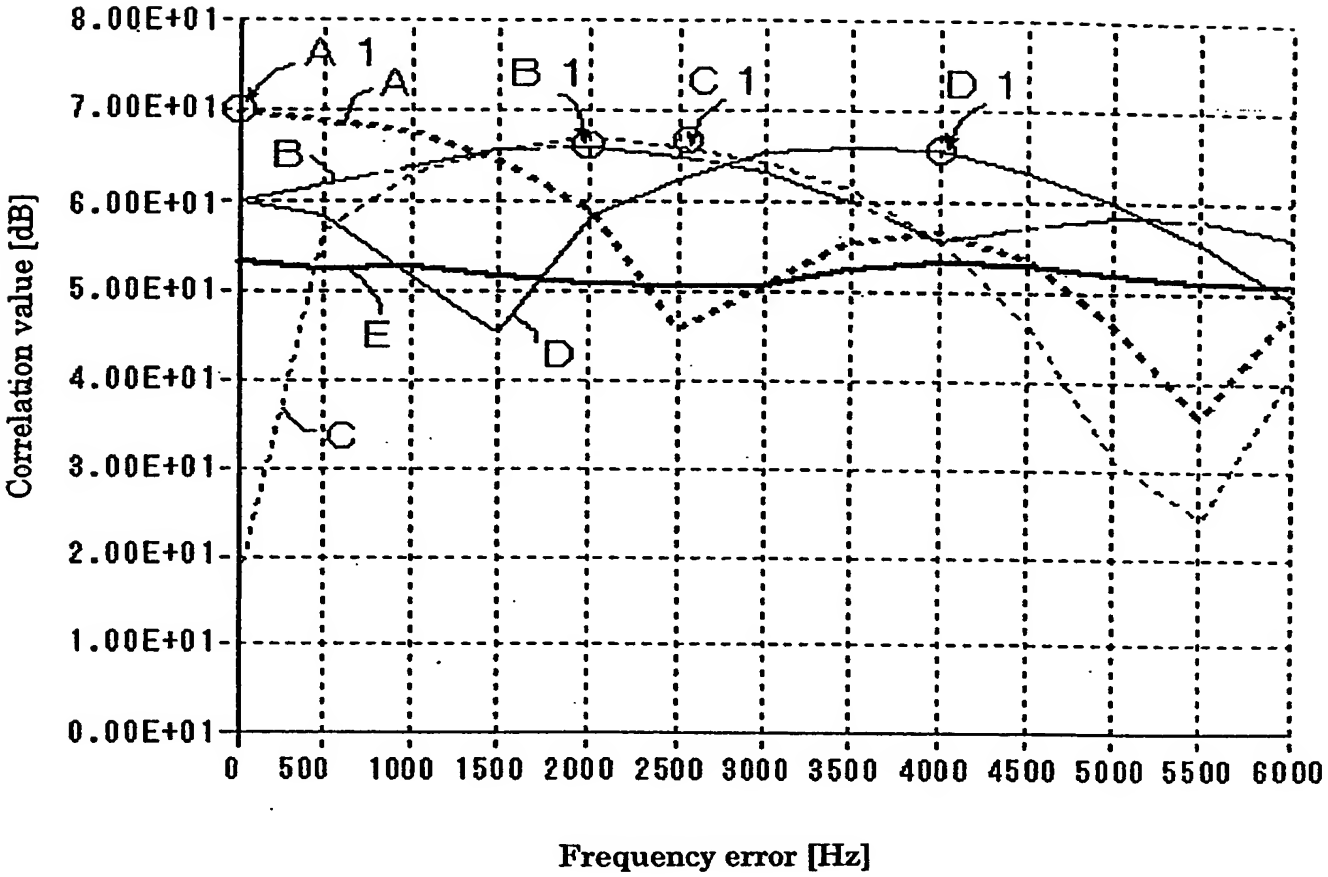

50
Measurement signal S(t)
Correlator
Correlation output
Corr (T)
40
Reference signal R0(t)
R0(t)
R(t)
10a
R1(t)
Frequency addition F1 Hz
10b
R2(t)
Frequency addition F2 Hz
Adder
10n
Rn(t)
Frequency addition Fn Hz

Fig. 7

Frequency Error vs. Correlation Value



A : 0Hz
B : 2kHz
C : 2.6kHz
D : 4kHz
E : Noise

Fig. 8

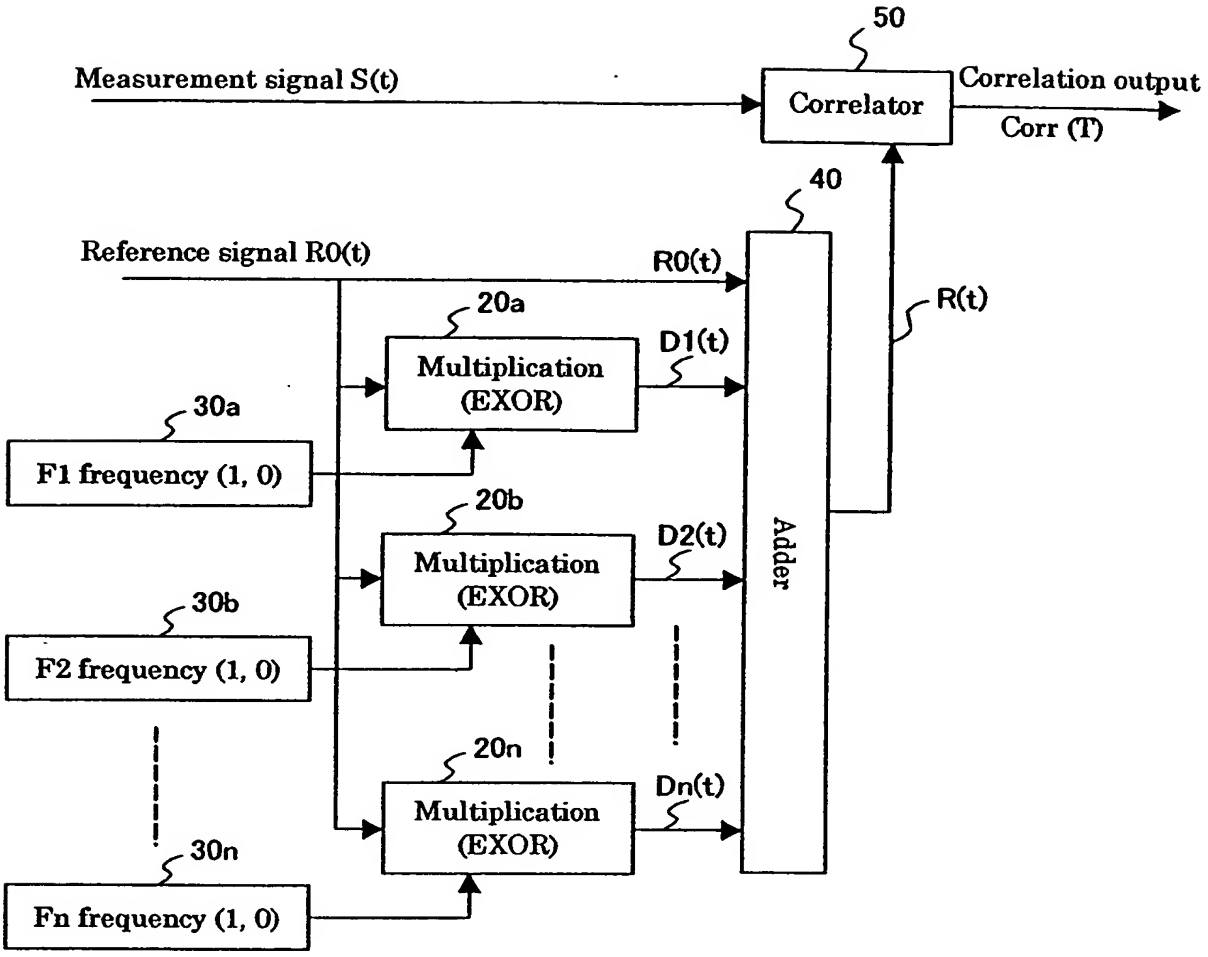

50
Measurement signal S(t)
Correlator
Correlation output
Corr (T)
40
Reference signal R0(t)
R0(t)
R(t)
20a
Multiplication
(EXOR)
D1(t)
30a
F1 frequency (1, 0)
20b
Multiplication
(EXOR)
D2(t)
Adder
30b
F2 frequency (1, 0)
20n
Multiplication
(EXOR)
Dn(t)
30n
Fn frequency (1, 0)

Fig. 9

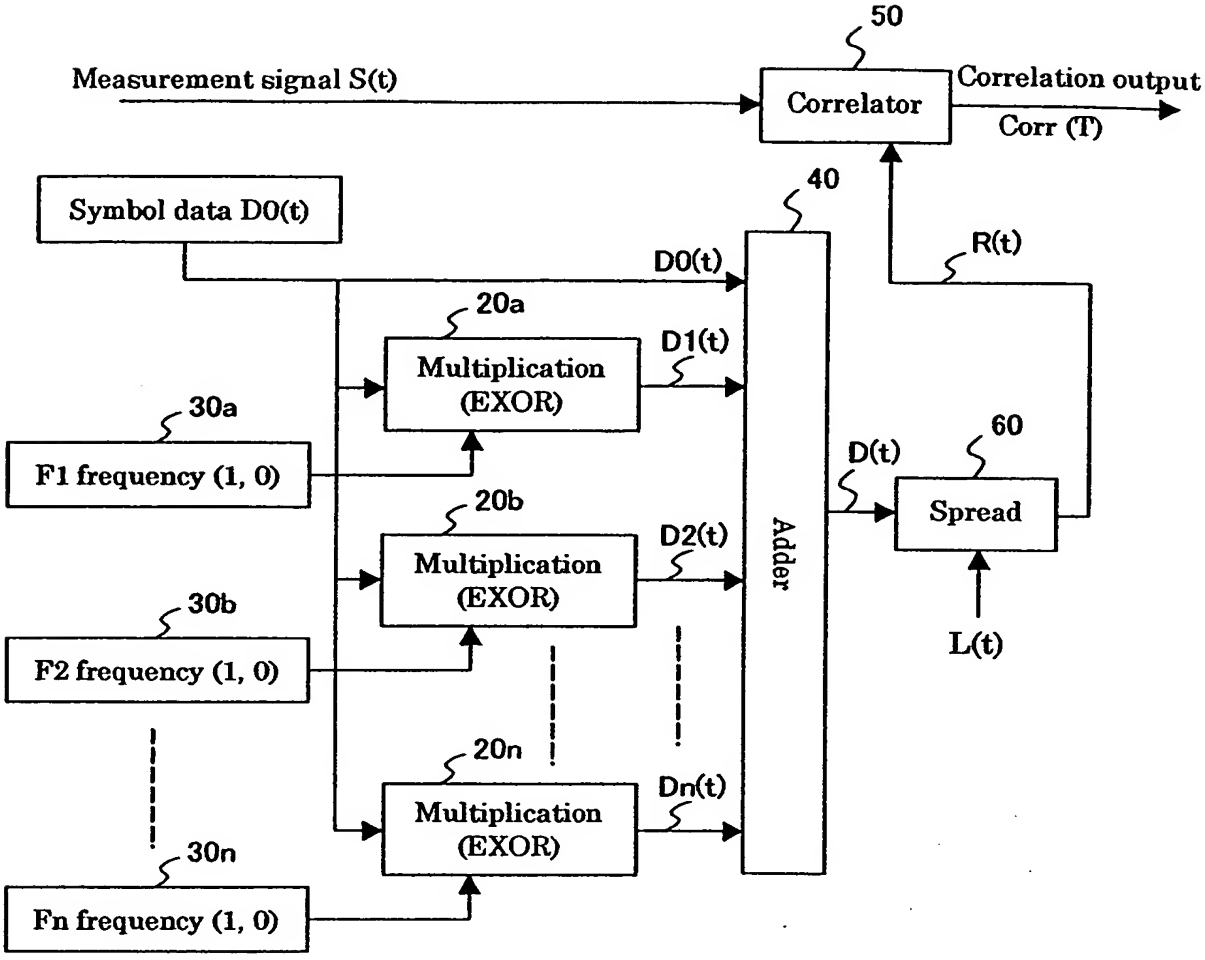
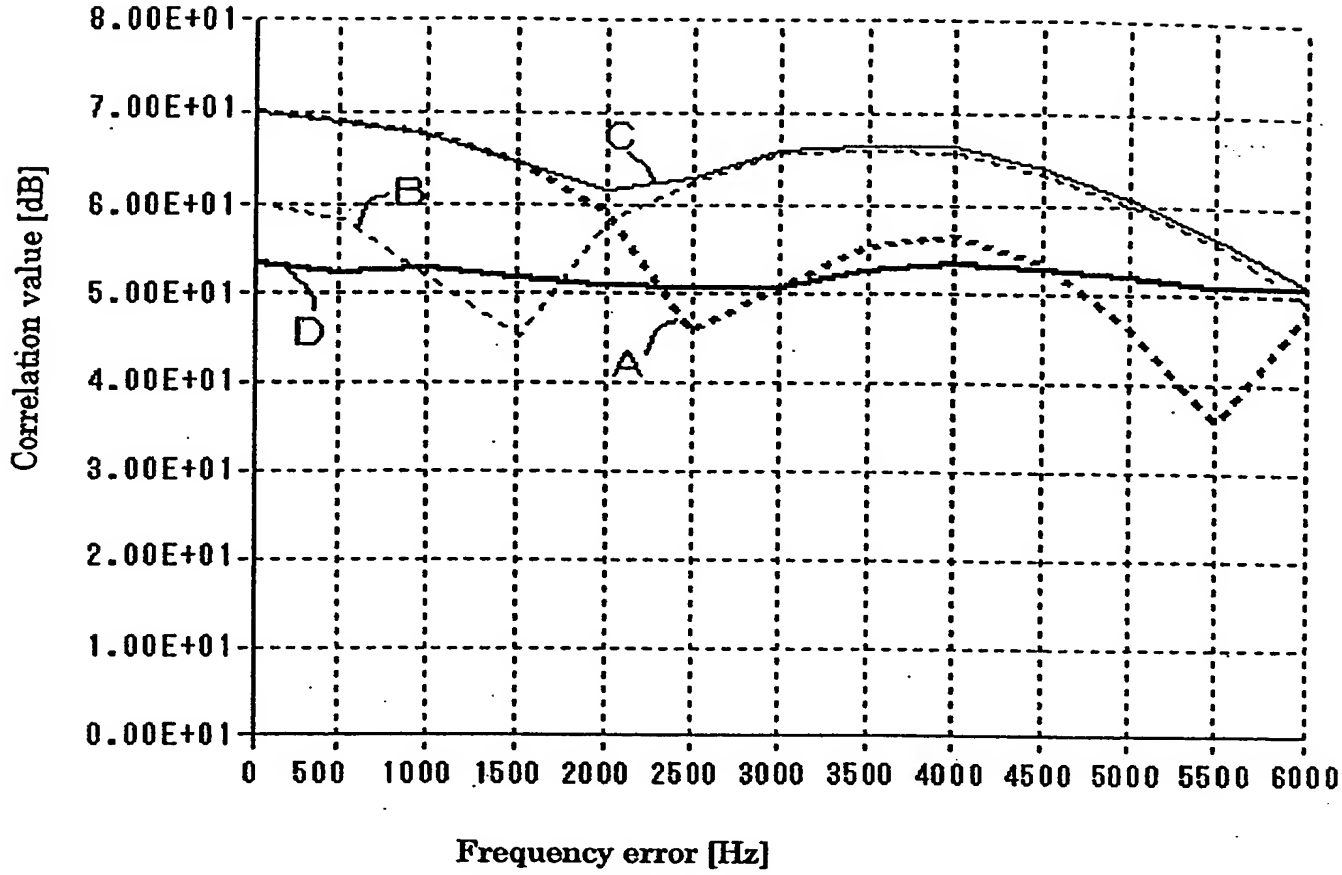

50
Measurement signal S(t)
Correlator
Correlation output
Corr (T)
40
Symbol data D0(t)
R(t)
D0(t)
20a
Multiplication
(EXOR)
D1(t)
30a
F1 frequency (1, 0)
D(t)
60
Spread
20b
Multiplication
(EXOR)
D2(t)
Adder
30b
F2 frequency (1, 0)
L(t)
20n
Multiplication
(EXOR)
Dn(t)
30n
Fn frequency (1, 0)

Fig. 10

Frequency Error vs. Correlation Value



A : Reference signal R0(t)
B : 4kHz-added reference signal Rn(t)
C : Result of addition of correlation value
D : Noise

Fig. 11

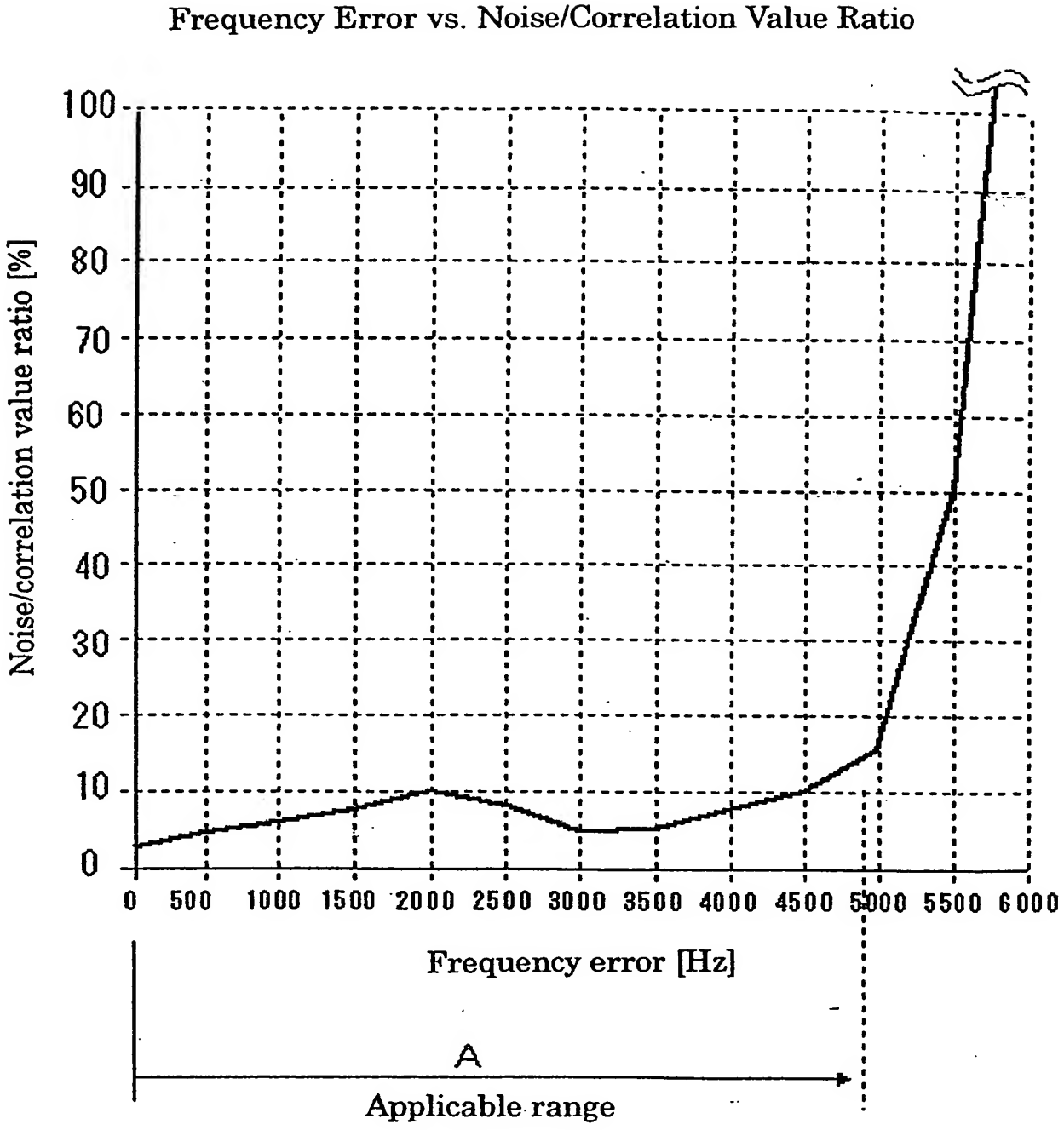
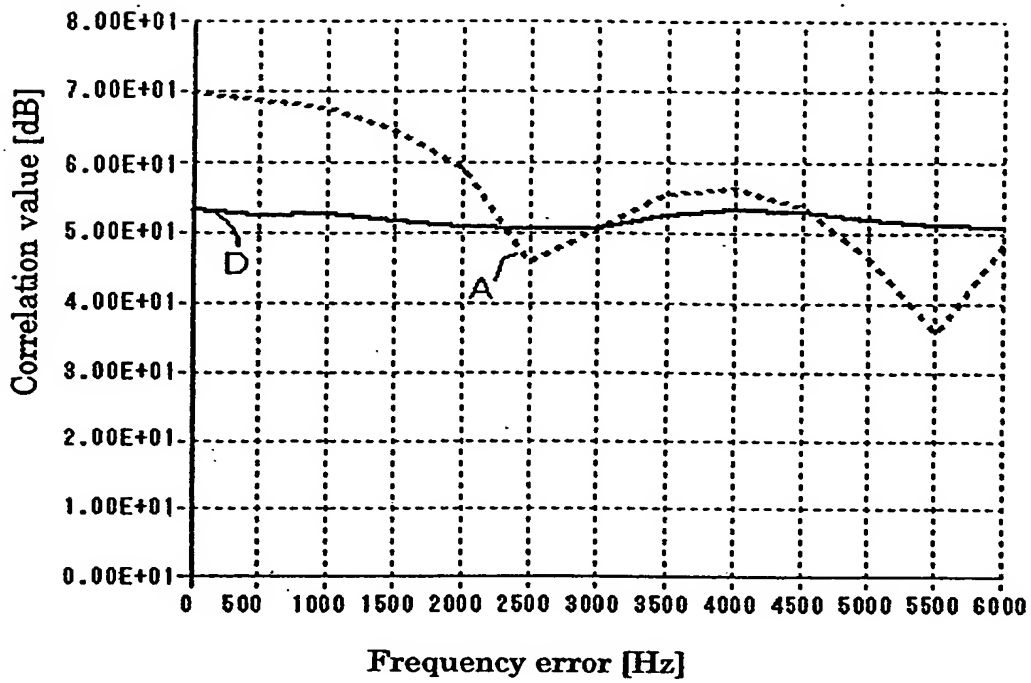

Frequency Error vs. Noise/Correlation Value Ratio
Noise/correlation value ratio [%]
100
90
80
70
60
50
40
30
20
10
0
0 500 1000 1500 2000 2500 3000 3500 4000 4500 5000 5500 6000
Frequency error [Hz]
A
Applicable range

Fig. 12

Frequency Error vs. Correlation Value



A : Reference signal R(t)

D : Noise

Fig. 13

Frequency Error vs. Noise/Correlation Value Ratio

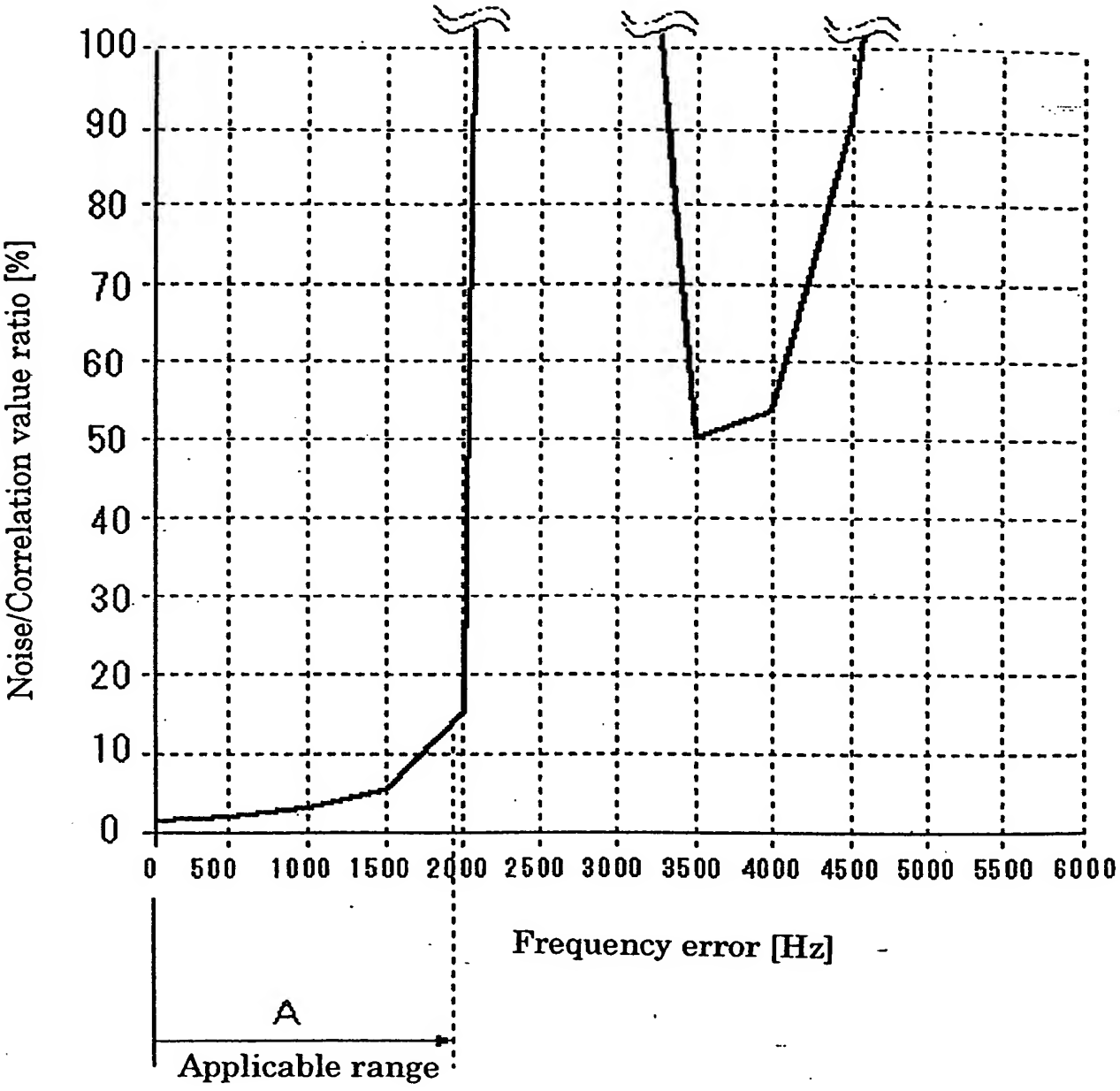


Fig. 14